Center Independent Research & Development: GSFC IRAD

Precision Formation Alignment Navigation System (pFANtASY)

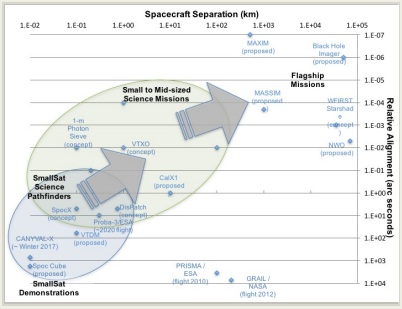
Completed Technology Project (2017 - 2018)

Project Introduction

The Precision Formation Alignment Navigation System, or pFANtASY, is an integrated guidance and navigation subsystem for the acquisition and fine alignment of a dual spacecraft distributed science instrument mission. pFANtASY will acquire another spacecraft at up to 100m distance at 18 m down to 5-micron accuracy. This is achieved by a staggered set of instruments used for sensing illuminated spots on the target spacecraft. Initial acquisition is achieved with a camera-based acquisition mode that senses a set of illuminated beacons to 18m to 1 cm accuracy. Then a precise centration system comprised of a laser optic and quad-cell detector to sense relative position from 2 cm down to 20 micron accuracy. These sensor signals are ingested into navigation software to eliminate noise and produce the <5micron 3-sigma accuracy required. The components currently selected take an estimated 3 kg mass, 10 W power, and 4U volume but can be scaled to meet the needs of larger spacecraft.

Anticipated Benefits

pFANtASY will enable a new class of science investigations needing instrumentation distributed across multiple spacecraft platforms. These distributed spacecraft missions span the 4 primary NASA science disciplines of astrophysics, earth science, heliophysics, and planetary sciences. The concepts developed span the NASA mission classes, ranging from Small Satellite technology demonstration missions all the way to flagship science missions. pFANtASY is designed for a small sat platform and will enable small sat missions seeking to employ a distributed instrument architecture. By demonstrating the ability to acquire micron level relative position sensing, pFANtASY will reduce risk for larger SMEX, MIDEX, and flagship-class science missions.



Concepts developed and proposed that require distribtued spacecraft missions span the Science realms. Mission class ranges from Small Sat through Flagship. pFANtASY demonstrated on a Small Sat platform reduces risk for all of…

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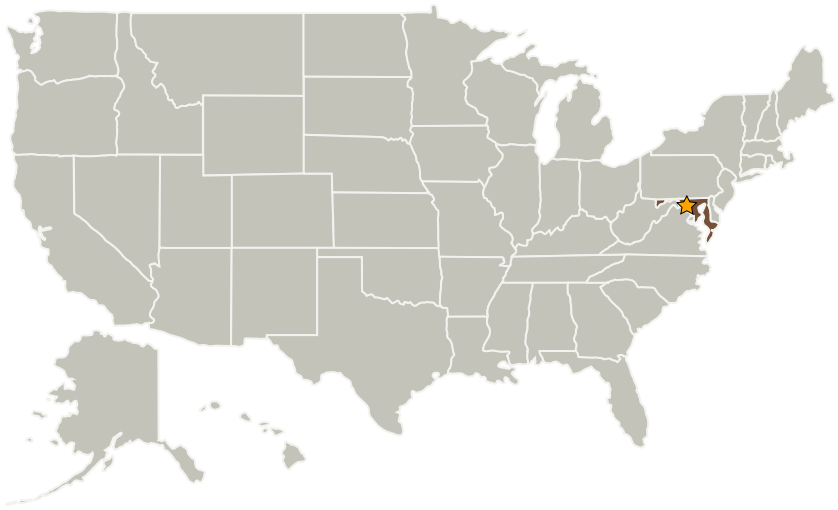
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Jason W Mitchell
Michael A Johnson

Principal Investigator:

Neerav Shah

Co-Investigators:

Philip C Calhoun
Anne-marie D Novo-gradac
Guangning Yang
Gerardo E Cruz-ortiz
Sean R Semper

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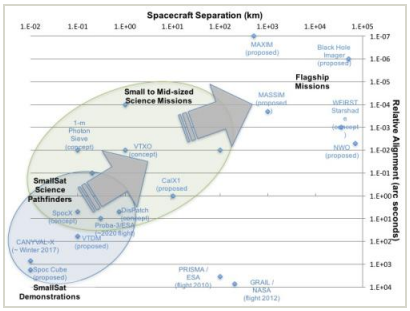
Images

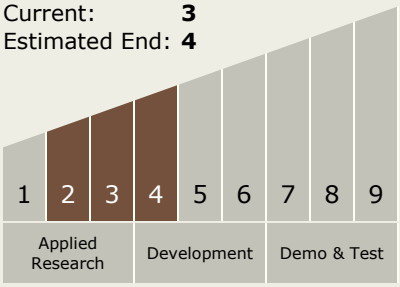


NASA Science mission concepts that need pFANtASY for precision relative alignment between spacecraft

Concepts developed and proposed that require distribtued spacecraft missions span the Science realms. Mission class ranges from Small Sat through Flagship. pFANtASY demonstrated on a Small Sat platform reduces risk for all of these missions.
(https://techport.nasa.gov/image/28182)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.5 GN&C Systems Engineering Technologies
    - TX17.5.1 GN&C System Architectures, Requirements and Specifications

Other/Cross-cutting:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.1 Guidance and Targeting Algorithms
    - TX17.1.1 Guidance Algorithms
    - TX17.1.2 Targeting Algorithms
  - TX17.2 Navigation Technologies
    - TX17.2.1 Onboard Navigation Algorithms
    - TX17.2.3 Navigation Sensors

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Technology Areas *(cont.)*

- TX17.4 Attitude Estimation Technologies
  - TX17.4.3 Attitude Estimation Sensors
- TX17.5 GN&C Systems Engineering Technologies
  - TX17.5.4 GN&C Ground Testbeds/Test Facilities
  - TX17.5.7 End-to-End Modeling and Simulation of GN&C Systems

Target Destinations

The Sun, Earth, Others Inside the Solar System

Supported Mission Type

Push